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(54) Sheath for forming an internal lining for a conduit and a process for using the sheath

(57) A sheath for forming an internal lining for a conduit, which may be damaged for example, comprises a sheet of flexible material, which is formed into a tube whose inside surface is smooth and fluid-tight and whose outside surface is an integral part of a covering means which is coated with an adhesive material. The flexible material may be polyethylene or polyvinyl chloride for example, and the tube may be two to three hundred metres in length. The sheath may be applied to a conduit to be lined by the use of expansible plugs and fluid under pressure.

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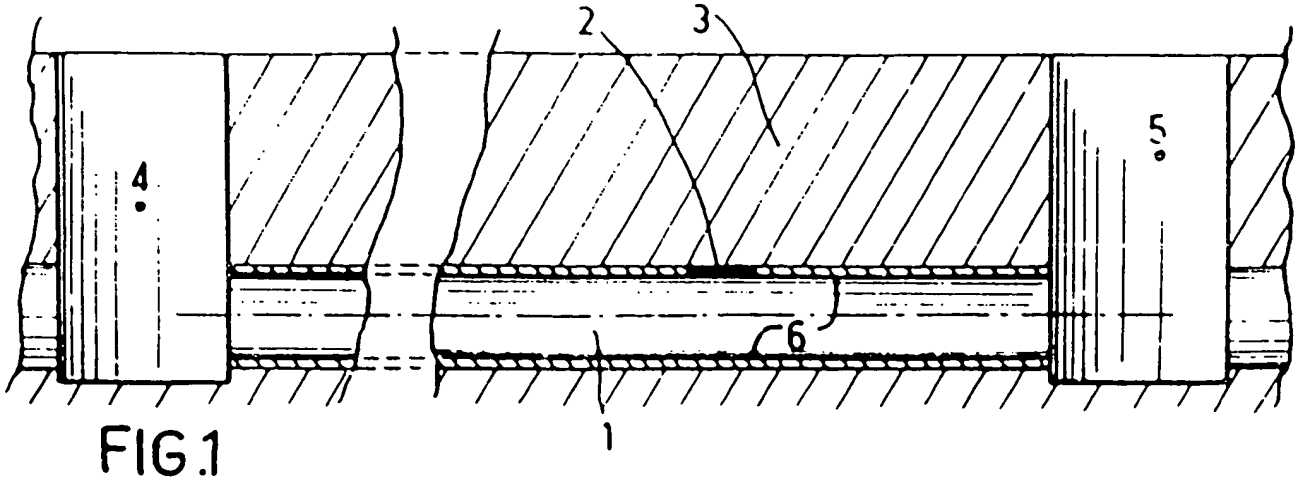


FIG.1

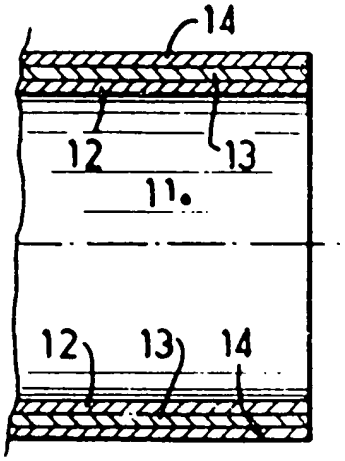


FIG.5

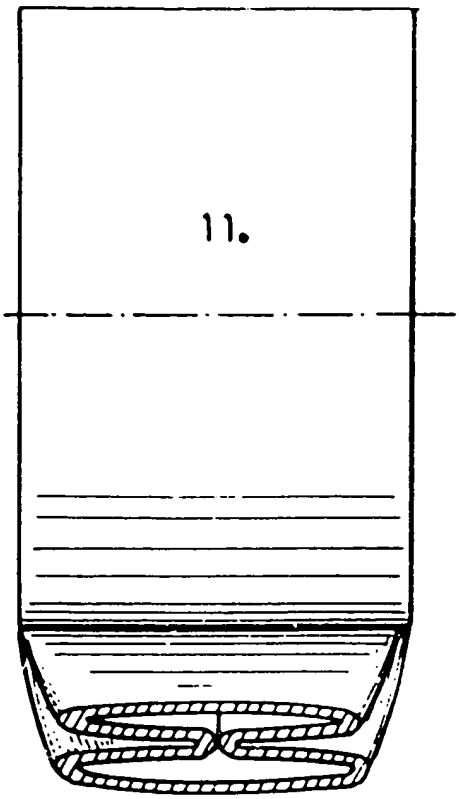


FIG.6

FIG.2

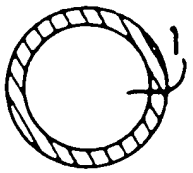


FIG.3

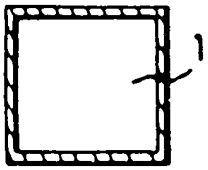
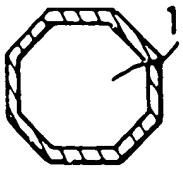


FIG.4



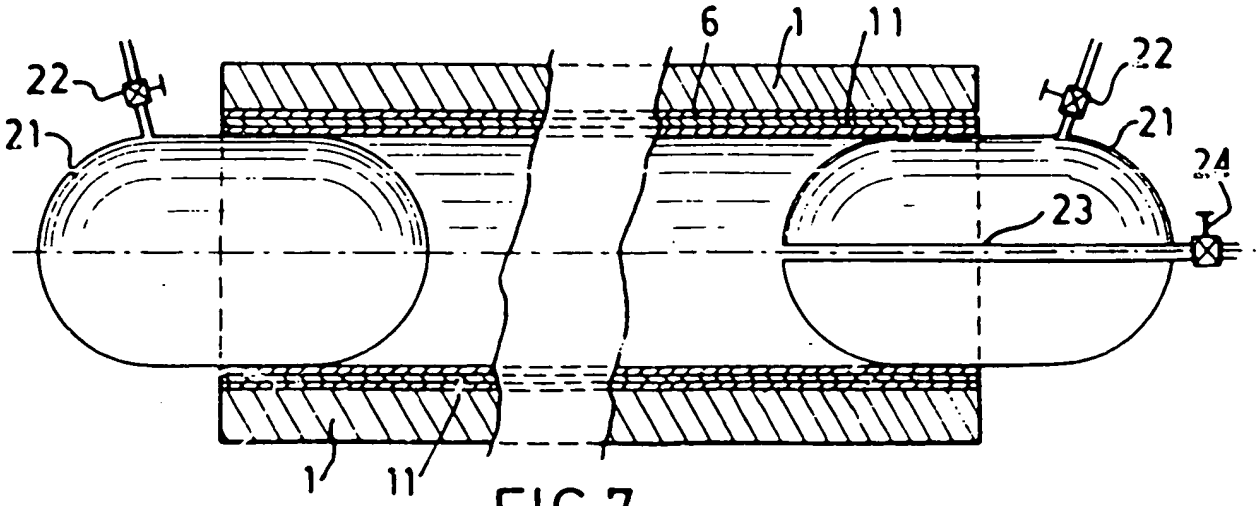


FIG.7

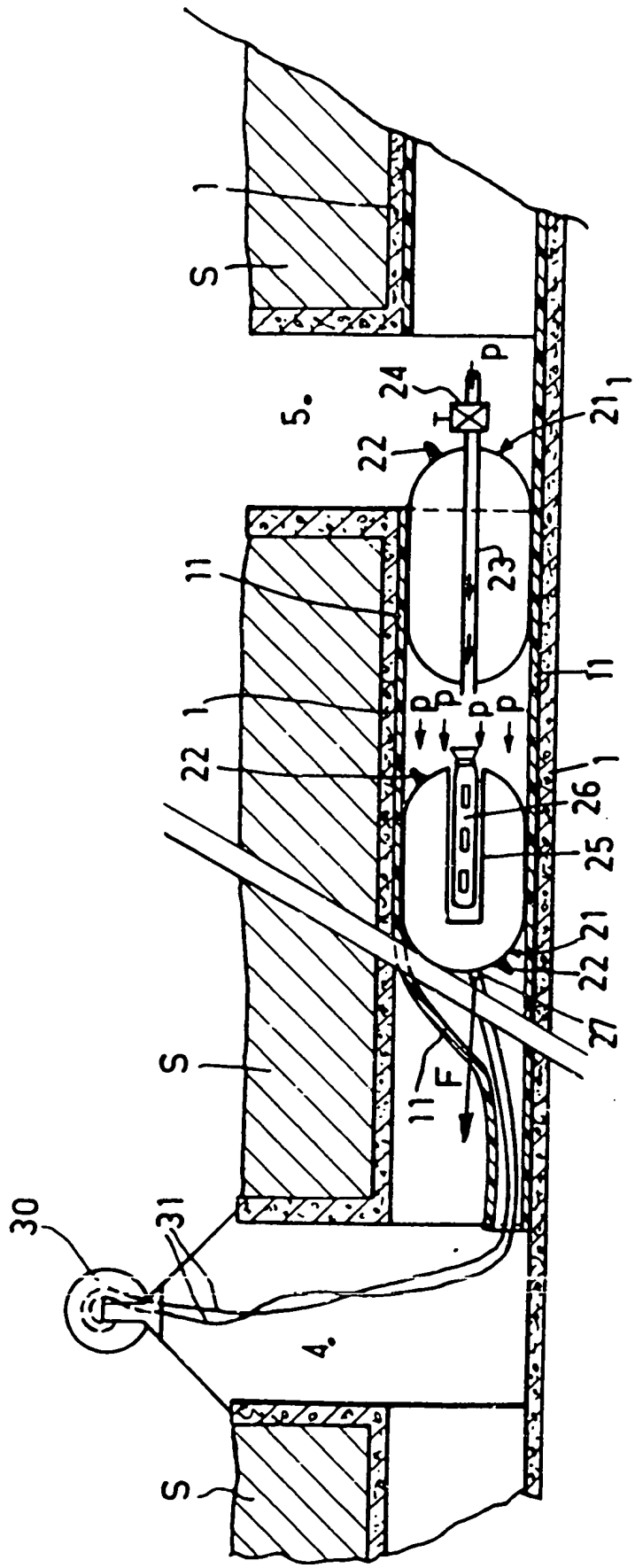


FIG.8

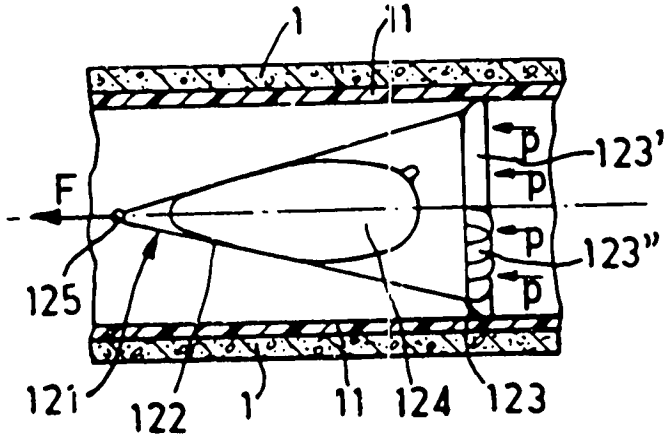


FIG.9

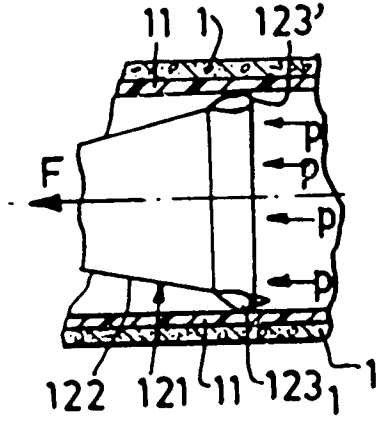


FIG.10

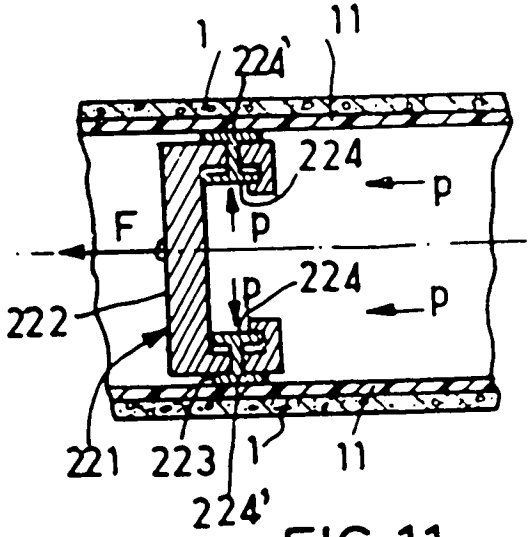


FIG.11

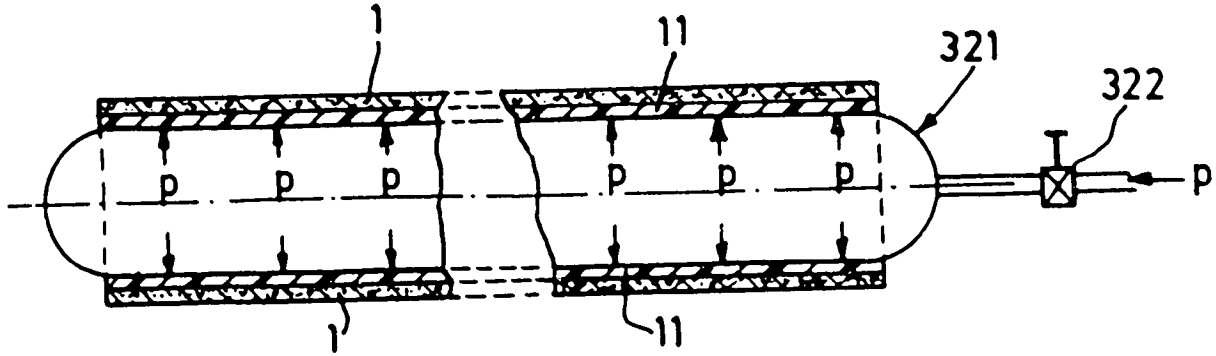


FIG.12

SPECIFICATION

Sheath for forming an internal lining for a conduit and a process for using the sheath

The present invention concerns a sheath for forming an internal lining for a conduit, and a process for using the sheath.

It will be appreciated that the conduit may be horizontal, inclined or vertical (sewage downpipe) and that it may be damaged by fracture, cracking, corrosion, holing, etc.

In the present state of the art, damage which is not of great extent is remedied for example by injecting resin under pressure, although this can cover only a few square centimetres, or else the conduit is internally sheathed by means of tubes which are about 1 metre in length and which have to be connected together by welding and/or sticking. This operation is a long and difficult one, its results are not always guaranteed, and the numerous connections give rise to turbulence phenomena, pressure drops and weak points.

The aim of the present invention is to eliminate these disadvantages and these defects.

Briefly, the present invention concerns a sheath for forming an internal lining for a conduit, which may be damaged for example, characterised in that said sheath comprises a sheet of flexible material, which is formed into a tube whose inside surface is smooth and fluid-tight and whose outside surface is an integral part of a covering means which is coated with an adhesive material. The flexible material may be polyethylene or polyvinyl chloride for example, and the tube may be two to three hundred metres in length. The covering means may be a sponge material or a natural or artificial, woven or non-woven textile material. The adhesive material may be a thermosetting resin.

The sheath according to the invention can be wound in a coil after it has been put into a flat form, preferably with two double side folds whereby the tube is folded into the cross-sectional shape of two M-shapes which are joined together by way of the bottom ends of the legs of the M-shapes; in this way, the width of the sheath when flat is less than the diameter of the corresponding conduit, and it is then easy to introduce the sheath into the conduit at an accessible point, for example a manhole, and for the sheath to be pulled through the conduit by cable to the manhole which is at the other side of the damaged position in the conduit.

Briefly, the present invention concerns a process for using the internal lining sheath, characterised in that at least one expansible plug member is introduced into said sheath, to apply said sheath against the conduit.

Briefly, the present invention further concerns a process for using said sheath, characterised in that an expansible plug member is introduced at each end of the sheath which is set in place in the conduit, which expansible plug member sealingly applies the end of the sheath against the conduit; a fluid is passed under pressure into the internal volume of the sheath by way of at least one pipe which passes through an expansible plug member, whereby the sheath is applied against the conduit; and the pressure is maintained for the period of time required for setting of said adhesive material.

The expansible plug members may be inflatable balloon members, with taps or cocks. The fluid may be hot air, at a pressure for example of from 0.1 to 2.0 or 0.5 to 2.0 bars. After sticking, and, where appropriate, after polymerisation and hardening of the thermosetting resin, the pressures are reduced and the balloon members are removed.

The present invention further concerns an improved process for using said sheath, which makes it possible for the sheath to be perfectly applied against the conduit in such a way that the sheath is totally smooth, without folds or deformation of any kind, and the sheath does not suffer any damage when it is so applied.

In accordance with a preferred embodiment of the improved process according to the invention, the plug member is introduced at one end of the sheath and a second expansible plug member is subsequently introduced at the same end of the sheath, the second plug member sealingly applying the end of the sheath against the conduit; by means of at least one pipe which passes through said second plug member, a fluid is passed under pressure into the inside volume of the sheath, to permit displacement of said first plug along the sheath as far as the other end thereof, where said first sheath is held thereby to close off said other end of the sheath and substantially to seal said other end; said first plug member, upon being displaced along the sheath, and the fluid under pressure, applying said sheath perfectly against the conduit; and the fluid pressure is maintained for the period of time required for setting of the adhesive material which coats the covering means which forms the outside surface of said sheath.

In this same embodiment, said first plug member is displaced along the sheath either by the action of the fluid pressure which is applied to one of its ends only and/or by a mechanical pulling force which is applied to the other of its ends.

In addition, in the same embodiment, the first plug member is provided with equipment for continuous monitoring of the sheath when it is applied against said conduit.

The pressures used for moving the first plug member through the sheath and for applying the sheath against the conduit may be relatively low.

By means of the sheath and the process according to the invention, the lining operation is quick and easy, provides good results, and does not give rise to turbulence phenomena nor pressure drops. On the contrary, as the inside surface of the sheath is and remains perfectly smooth, this gives rise to an increase in the flow speed; by way of example, increases in the flow rate have been measured as reaching 25%. In addition, by suitable selection of the material used for the sheath, it is possible to use the conduit for fluids which it was not previously able to accept, for example liquids which are corrosive or which attack the conduit.

Embodiments of the invention will now be de-

scribed by way of non-limiting example with reference to the accompanying drawings in which:

Figure 1 is a view in vertical section through the axis of a buried conduit, with a break along the length of the conduit;

Figures 2, 3 and *4* are cross-sectional views showing possible sections of the Figure 1 conduit;

Figure 5 is a view in axial section of a sheath according to the present invention, with a break in the length of the sheath;

Figure 6 is a front view showing the folding at the end of the sheath of Figure 5, the sheath being wound in a coil after having been flattened;

Figure 7 is a view in vertical axial section of a conduit in the course of the sheathing process according to the present invention; with a break along the length of the conduit,

Figure 8 is a diagrammatic view of an embodiment of the improved process;

Figure 9 is a diagrammatic view of two embodiments of the first plug member which is used in the improved process;

Figure 10 is a diagrammatic view of another embodiment of the first plug member which is used in the improved process;

Figure 11 is a diagrammatic view of yet another embodiment of the first plug member which is used in the improved process; and

Figure 12 is a diagrammatic view of another embodiment of the improved process.

Referring to Figure 1, conduit 1 which is damaged at 2 is buried in the ground 3 and is accessible on respective sides of the damaged position 2 by way of two manholes 4 and 5. The conduit 1 is of any cross-section; for example round (Figure 2), or square (Figure 3) or polygonal (octagonal in Figure 4). The tranverse dimensions of the conduit may range for example from 150 mm to 3 metres. The inside wall 6 of the conduit 1 is possibly cleaned, brushed, scraped, chipped, etc. It will be appreciated that the horizontal conduit 1 may also be inclined or vertical, and may be for example a sewage downpipe.

Referring to Figure 5, in accordance with the present invention the sheath 11 is made from a sheet of a flexible material, for example polyethylene or polyvinyl chloride. The sheet which comprises a smooth, fluid-tight face is formed into a tube 12, with the smooth face facing inwardly of the tube. It will be appreciated that the diameter of the tube is suited to the conduit to be sheathed, and the tube may be up to 200- 300 metres in length. The outside surface of the tube 12 is an integral part of a covering means 13 such as a sponge material or a natural or artificial, woven or non-woven textile material, which is fixed on to the tube 12 for example by flocking or by hot pressure adhesion. The covering means 13 is coated with an adhesive material 14, for example a thermosetting resin (polyester or epoxy). The coating operation may be effected in situ, with a roller, with a gun or by soaking in a bath and draining. The sheath 11 is then folded into three or four folds, for example in the form of two M-shapes which are joined together by way of the bottom ends of the legs of the M-shapes (Figure 6), and rolled into a cylindrical configuration. It is thus easy for the sheath to be pulled through the conduit by means of a cable, in order to set it in position in the conduit 1 (Figure 7).

In the process according to the invention, an expansible plug member is introduced at each end of the sheath 11 after it has been set in position in the conduit 1. In Figure 7, the expansible plug members are inflatable balloon members 21 with taps or cocks 22, which balloon members may however be of another expansible type, for example being expansible mechanically or hydraulically, provided that they sealingly apply the end of the sheath 11 against the end of the inside wall 6 of the conduit 1. One of the expansible plug members 21 (or both the plug members) has a pipe 22 passing through it, the pipe having a tap or cock 24, by which of which pipe a fluid may be passed under pressure into the internal volume of the sheath 11 which is thereby applied over its entire outside surface against the wall 6, on the adhesive 14 which sticks it; the fluid may be hot air, for example at a pressure of from 0.5 to 2 bars. After the time required for the sticking operation, possibly after polymerisation of the thermosetting resin used as the adhesive, the taps or cocks 24 and then 22 are opened, thereby removing the pressure from the assembly, and the plug members 21 are withdrawn.

In Figure 8, the portion of a conduit 1 which is buried in the ground s and which is to be sheathed is isolated between two access pits or manholes 4 and 5. The sheath 11 is firstly introduced into the conduit 1, after the outxide wall thereof has been coated with an adhesive. A first expansible plug member 21 is then introduced into the sheath 11, by way of one of the access pits 4 and 5. In the embodiment shown in Figure 8, the plug member is a balloon member which is inflatable by way of an opening which can be closed by a tap or cock, for example (not shown in the drawing). On the side which is subjected to pressure (p), the plug member 21 has a housing 25 for a survey apparatus, for example a television viewing apparatus 26, which is arranged to view the inside of the conduit and which may be connected to a receiver above the surface of the ground s. The cable arrangement may for example pass through the plug member 21 over its length in a sealed conduit and may issue from the sheath by way of the access pit 4 to a monitoring station (not shown). The end of the plug member 21 which is not subjected to the pressure p (being the end which is towards the access pit 4) is provided with a connecting means 27 for connecting a traction cable (or the like) 31 which is operated by a winch 30 or the like. The plug member 21 is provided with at least one aperture 22 which is capable of being closed. After the plug member 21 has been introduced into the sheath 11, the plug member 21 is inflated to a pressure which is sufficient to ensure that the sheath 11 is applied against the conduit 1, while permitting the plug member to slide in the direction indicated by arrow F. The plug member 21 is then pulled along the sheath 11 in the direction indicated by arrow F by the cables or the like 31, over a small distance, in order to permit a second plug member 21, also to be introduced into the sheath. The second plug mem-

ber 21, is also in the form of a balloon member which is inflatable by way of a closable aperture 22. The second plug member is inflated to a pressure which is sufficient to close off the sheath 11, at the end which is towards the access pit 5. The second expansible plug member, which closes off the sheath 11, has passing therethrough a pipe 23 with a tap or cock 24, by means of which a fluid may be passed under a pressure p into the internal volume of the sheath 11. The pressure p acts on the one hand against the sheath and presses it firmly against the inside wall of the conduit, and on the other hand, against the expansible plug member 21 which it pushes along the sheath 11 towards the access pit 4. The movement of the plug member 21 along the sheath ensures that the sheath 11 is perfectly applied against the conduit, without there being any possibility of folds and deformation occurring. Thus, the air which is between the sheath 11 and the conduit 1 is pushed out. In order to be able to guard against possible damage, the movable plug member 21 may be provided with a survey system 25 and 26 for surveying the sheath while it is being applied against the conduit 1. The movement of the plug member 21 along the sheath may be facilitated by pulling on the cables or the like at 31. When the plug member 21 has reached the other end of the portion of the conduit 1 which is to be sheathed, namely at the access pit 4, the plug member 21 remains in position and serves to close off the sheath. If necessary, the pressure in the plug member 21 can then be slightly increased.

The pressure p is maintained within the sheath, until the end of the sticking process (or the process of polymerisation of the thermosetting resin used as the adhesive).

Figures 9 to 11 show other embodiments of an expansible plug member. In Figure 9, the plug member 121 is formed by an expansible conical casing 122 whose fluid-tight apex is pointing towards the access pit 4. The base opening of the casing 122 is provided along its periphery with a ring 123 made of a flexible and/or expansible material. The ring may be formed in one piece (see the top part in Figure 9) or may be made in the form of petal members which overlap each other (see the bottom part in Figure 9) or may be made in the form of a peripheral air chamber 123' which can be inflated by way of closable apertures 126 (see Figure 10). The casing 122 must be made so that it is capable of being expanded and is also fluid-tight; any material (metal or otherwise) can therefore be used. Expansion of the casing may be effected for example by means of an inflatable bag 124. A means 125 for connecting cables 31 or the like is disposed at the apex of the casing. The casing must be sufficiently rigid to ensure that the ring 123 is applied against the sheath 11 and thus to ensure that the sheath 11 is firmly pressed against the conduit 1. The plug member 121 may also be provided with a system for surveying the sheath when it is being pressed against the conduit, as the plug member is displaced along the sheath under the pressure p of the fluid and possibly the pulling force applied at 125 by the cables 31 or the like. Another embodiment of the plug member 221 is shown in Figure 11. The plug member is in the form of a piston 222. At least one sealing means 223 is applied against the sheath 11 by a ring 224' which is subjected to the pressure p of the fluid which acts on a ring 224 which operates as a piston. It is also possible to employ a spring (not shown in the drawing) for applying the sealing means against the sheath 11.

Many improvements and modifications may be made in the embodiments of the plug members 21, 121 and 221, without thereby departing from the scope of the invention.

Referring now to Figure 12, this also shows another embodiment of the process according to the invention. This process uses a single plug member 321 which can be inflated for example by way of the cock or tap 322. The inflation pressure p presses the plug member 321 against the sheath 11 and presses the sheath 11 against the conduit 1. Plug members of this kind may be of considerable lengths, up to 120 metres and even more. In some cases, this particularly simple form of the process may be appropriate where it is found that handling several plug members for example is difficult.

Many modifications and improvements may be made without thereby departing from the scope of the invention. Thus, it is possible for example for the sheath to be introduced into the conduit, in the form of an unwelded folded strip, and for the longitudinal edges of the strip to be joined in the conduit, in the operation of sticking or polymerising the adhesive layer.

It is within the scope of the invention for the sheath and the process using the sheath to be used for sheathing pipes in general, for example pipes which are required to carry toxic and/or corrosive fluids or for reducing the coefficient of friction of the conduits which are made for example of concrete, cast iron, etc.

CLAIMS

1. A sheath for forming an internal lining for a conduit, which may be for example damaged, characterised in that said sheath comprises a sheet of flexible material which is formed into a tube whose inside surface is smooth and fluid-tight and whose outside surface is an integral part of a covering means which is coated with an adhesive material.

2. A sheath according to claim 1 characterised in that said flexible material is polyethylene.

3. A sheath according to claim 1 characterised in that said flexible material is polyvinyl chloride.

4. A sheath according to one of the preceding claims characterised in that said adhesive material is a thermosetting resin.

5. A sheath according to one of the preceding claims characterised in that it is folded with two double side folds imparting thereto a cross-sectional shape formed by two M-shapes which are joined together by way of the bottom ends of their legs.

6. A process for using an internal lining sheath for a conduit, according to one of claims 1 to 5, characterised in that at least one expansible plug

member is introduced into said sheath to apply said sheath against the conduit to be sheathed.

7. A process for using the sheath according to claim 6 characterised in that an expansible plug member is introduced at each end of the sheath which is set in place in the conduit, which expansible plug member sealingly applies the end of the sheath against the conduit; a fluid is passed under pressure into the internal volume of the sheath by way of at least one pipe which passes through an expansible plug member, whereby the sheath is applied against the conduit; and the pressure is maintained for the period of time required for setting of said adhesive material.

8. A process according to claim 7 characterised in that said plug member is introduced at one end of the sheath and a second expansible plug member is subsequently introduced at the same end of said sheath, which second expansible plug member sealingly applies the end of the sheath against the conduit; a fluid is passed under pressure into the internal volume of the sheath by way of at least one pipe which passes through said second expansible plug member, thereby to cause displacement of the first plug member along the sheath to the other end thereof, where said first plug member is held so as to close off said other end of the sheath and to substantially seal said other end; said first plug member, during its movement along the sheath, and the fluid under pressure, applying said sheath perfactly against the conduit; and the pressure of the fluid is maintained for the period of time required for setting of the adhesive material which coats the covering means which forms the outside surface of said sheath.

9. A process according to claim 8 characterised in that said first plug member is displaced along the sheath either by the action of the pressure of the fluid applied to one of its ends only and or by a mechanical pulling force applied to the other of its ends.

10. A process according to claim 8 or claim 9 characterised in that said first plug member is provided with apparatus for continuously surveying the sheath when it is applied against said conduit.

11. A process according to any one of claims 6 to 10 characterised in that said second plug member is an inflatable balloon member.

12. A process according to any one of claims 6 to 11 characterised in that said first plug member is an inflatable balloon member.

13. A process according to any one of claims 8 to 12 characterised in that, when said first plug member arrives at said other end of the sheath, said first plug member is held in place by an increase in its inflation pressure.

14. A process according to any one of claims 8 to 10 characterised in that said first plug member comprises an expansible conical casing whose apex is sealed and is directed towards said second end of said sheath; and in that the base opening is provided (at its periphery) with a ring made of a material which permits said ring to be firmly applied against the sheath by expansion of the conical casing and/or the pressurised fluid, without damaging said sheath when said first plug member is displaced along said sheath.

15. A process according to claim 14 characterised in that said ring is of an elastomer material and is made in one piece or in the form of petal members or in the form of a peripheral inflatable air chamber.

16. A process according to one of claims 8 to 10 characterised in that the plug member is in the form of a piston which is provided at its periphery with sealing means which are applied against the sheath by the pressurised fluid.

17. A process according to one of the preceding claims characterised in that said fluid is introduced at a pressure of from 0.10 to 2 bars, which pressure may be maintained for the period of time required for polymerisation and hardening of the thermosetting resin.

18. A process according to claim 17 characterised in that said fluid is hot air.

19. A process according to claim 17 or 18 in which the pressure is from 0.5 to 2.0 bars.

20. A sheath for forming an internal lining of a conduit substantially as herein described with reference to, and as illustrated in the accompanying drawings.

21. A process for applying an internal lining sheath within a conduit, substantially as herein described with reference to, and as illustrated in, the accompanying drawings.

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